



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---------------------------------|-------------|-----------------------|---------------------|------------------|
| 10/616,163 | 07/09/2003 | Kamal Kishore Goundar | ASMJP.135AUS | 9751 |
| 20995 | 7590 | 09/22/2004 | EXAMINER | |
| KNOBBE MARTENS OLSON & BEAR LLP | | | HARRISON, MONICA D | |
| 2040 MAIN STREET | | | ART UNIT | |
| FOURTEENTH FLOOR | | | PAPER NUMBER | |
| IRVINE, CA 92614 | | | 2829 | |

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/616,163

Applicant(s)

GOUNДАР, KAMAL KISHORE

Examiner

Monica D. Harrison

Art Unit

2829

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 4-13, 15, and 17-22 are rejected under 35 U.S.C. 102(e) as being anticipated by Xia et al (US 2002/0142578 A1).

1. Regarding claim 1, Xia et al discloses a method for depositing a silicon carbide layer onto a substrate, the method comprising steps of providing a silicon source, carbon source (pg. 3, paragraph 0046) and nitrogen source (pg. 3, paragraph 0047) and an inert gas into a reaction zone (pg. 2, paragraphs 0028-0031) the reaction zone containing the substrate (Figure 2, reference 290); producing an electric field in the reaction zone (pg. 2, paragraph 0031) the electric field generated using low and high frequency RF energy produced by an RF power supply (pg.2, paragraph 0030) the RF power supply generating an average power at an electrode surface used for plasma discharge in the reaction zone (pg.2, paragraphs 0029-0031); and reacting the silicon and carbon source gas to deposit a silicon carbide film on the substrate(Figure 3, reference 362; pg.2, paragraph 0034 thru pg.3); wherein the RF power supply generates high frequency RF power and low frequency RF power during a processing period (pg.2, paragraph 0030).

2. Regarding claim 4, Xia et al discloses wherein the average power at the electrode surface is substantially constant (pg.2, paragraph 0029).

3. Regarding claim 5, Xia et al discloses wherein the silicon and carbon source gas is one of the following: tri-methylsilane, tetra-methylsilane, or divinyl-dimethylsilane (pg.3, paragraph 0046).

4. Regarding claim 6, Xia et al discloses wherein the inert gas is one of the following: helium, argon or krypton (pg.2, paragraph 0047)

5. Regarding claim 7, Xia et al discloses wherein the nitrogen source in either one of the following or both: Ammonia (NH_3) or Nitrogen (N_2) (pg. 3, paragraph 0047).

6. Regarding claim 8, Xia et al discloses wherein the ratio of the silicon and carbon source gas to the inert gas is between about 1:1 and about 1:15 (pg.3, paragraphs 0044-0048).

7. Regarding claim 9, Xia et al discloses wherein the silicon and carbon source gas is provided into the reaction zone at a rate between about 200 sccm and about 500 sccm (pg.3, paragraphs 0044-0048).

8. Regarding claim 10, Xia et al discloses wherein the substrate is heated to a temperature between about 200 degrees Celsius and about 400 degrees Celsius (pg.4, paragraph 0053).

9. Regarding claim 11, Xia et al discloses, wherein the substrate is heated to a temperature between about 320 degrees Celsius and about 350 degrees Celsius (pg.4, paragraph 0053).

10. Regarding claim 12, Xia et al discloses wherein the reaction zone is maintained at a pressure between about 300 Pa and about 1000 Pa (pg. 3. paragraph 0048).

11. Regarding claim 13, Xia et al discloses wherein the reaction zone is maintained at a pressure between about 500 Pa and about 700 Pa (pg. 3. paragraph 0048).

12. Regarding claim 15, Xia et al discloses wherein the silicon carbide layer has a compressive film stress (pg.4, paragraph 0050).

13. Regarding claim 17, Xia et al discloses wherein the film is an etch stop layer (Figure 4D, reference 411).

14. Regarding claim 18, Xia et al discloses wherein the film is a hard mask (Figure 4D, reference 411; pg. 5, paragraph 0065).

15. Regarding claim 19, Xia et al discloses a method for manufacturing on a semiconductor substrate an interlayer structure containing a film in contact with a copper layer, comprising the steps of: (i) forming multiple layers on a semiconductor substrate (Figure 4A-4J); (ii) forming a hole for an interlayer connection of the multiple layers by etching (Figure 4H, reference 407); (iii) depositing copper in the hole (Figure 4J, reference 416); (iv) removing an excess of the copper from a top of the multiple layers (pg. 5, paragraph 0072), (v) depositing a silicon carbide film on the top of the multiple layers by plasma reaction, wherein the copper is covered by the silicon carbide film (Figure 4H, reference 409).

16. Regarding claim 20, Xia et al discloses wherein the multiple layers comprise a lower etch stop layer (Figure 4J, reference 403), a lower low dielectric layer (Figure 4J, reference 405), an intermediate etch stop layer (Figure 4J, reference 406), an upper low dielectric layer (Figure 4J, reference 408), and in step (ii) an upper etch stop layer laminated in sequence on the substrate (Figure 4J), and the hole is produced by forming a resist on top of the upper etch stop layer (Figure 4H, reference 407) and forming a via hole and trench by etching the multiple layers

Art Unit: 2829

using the resist (Figure 4I), and in step (iv) the resist and the upper etch stop layer are removed when removing the excess of the copper (Figure 4J).

17. Regarding claim 21, Xia et al discloses wherein prior to step (i), a low dielectric layer is formed on the substrate (Figure 4C, reference 403) and the multiple layers are formed on top of the low dielectric layer (Figure 4C).

18. Regarding claim 22, Xia et al discloses wherein steps (i) through (iv) are repeated at least once (Figures 4A-4J).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2 and 3 rejected under 35 U.S.C. 103(a) as being unpatentable over Xia et al (US 2002/0142578 A1).

19. Xia et al discloses RF power (pg.2, paragraph 0030), however, Xia et al does not disclose the specified frequencies and watts (claim 2), and power (claim 3). However, it would have been obvious, at the time the invention was made, to one with ordinary skill in the art, to provide the high and low range frequencies RF power and watts, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the “optimum range” involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Since it is well known that RF power is usually measured in watts, one with ordinary skill in the art would be able to use RF power to produce and calculate the necessary frequencies to come out with the specified power.

Claims 14 and 16 rejected under 35 U.S.C. 103(a) as being unpatentable over Xia et al (US 2002/0142578 A1) in view of Xia et al (6,759 327 B2).

20. Xia et al (US 2002/0142578 A1) discloses all above claimed subject matter except wherein the silicon carbide layer is nitrogen-doped, and wherein the nitrogen-doped silicon carbide layer has a dielectric constant less than about 5.0 (claim 14) and wherein the silicon carbide layer has a leakage current of less than $1 \times 10^{-8} \text{ A/cm}^2$ at an electric field of 1MV/cm (claim 16).

Xia et al (6,759 327 B2) discloses wherein the silicon carbide layer is nitrogen-doped, and wherein the nitrogen-doped silicon carbide layer has a dielectric constant less than about 5.0 (column 2, lines 65-67 thru column 3, lines 1-6) and wherein the silicon carbide layer has a leakage current of less than $1 \times 10^{-8} \text{ A/cm}^2$ at an electric field of 1MV/cm (column 9, lines 37-67 thru column 10, lines 1-31).

Since Xia et al (US 2002/0142578 A1) in view of Xia et al (6,759 327 B2) are from the same field of endeavor, the purpose disclosed by Xia et al (6,759 327 B2) would have been recognized in the pertinent art of Xia et al (US 2002/0142578 A1).

It would have been obvious at the time the invention was made to one with ordinary skill in the art to modify Xia et al (US 2002/0142578 A1) with the teachings of Xia et al (6,759 327 B2) for the purpose of providing a method of depositing low K barrier layers.

Art Unit: 2829

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica D. Harrison whose telephone number is 571-272-1959.

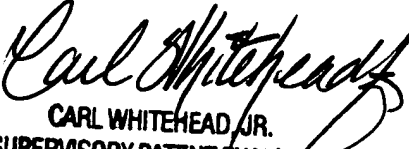
The examiner can normally be reached on M-F 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571-272-1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Monica D. Harrison
AU 2829

mdh
September 15, 2004


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800